Claims

1. A doubly doped lithium niobate crystal, wherein iron and a second radius-matched ion both are doped in the mean time into $LiNbO_3$, its composition being denoted as $Li_{1-x}Nb_{1+y}O_3$: Fe_m, M_n, where M is magnesium, indium, or zinc, when using q to denote the ion valence of M (q=2 when M is Mg or Zn, and q=3 when M is In), the values of x, y, m, and n are in the range of $0.05 \le x \le 0.13$, $0.00 \le y \le 0.01$, $5.0\times10^{-5} \le m \le 7.5\times10^{-4}$, and $0.02 \le qn \le 0.13$.

2. The doubly doped lithium niobate crystal as claimed in Claim 1, wherein said composition can doped with 0.007~0.03 wt.% Fe and 1.0~5.0 mol.% Mg, while the congruent composition is [Li]/[Nb]=0.90~0.95.

3. The doubly doped lithium niobate crystal as claimed in Claim 1, wherein said composition can doped with 0.01~0.05 wt.% Fe and 0.75~3.0 mol.% In, while the congruent composition is [Li]/[Nb]=0.91~0.95.

4. The doubly doped lithium niobate crystal as claimed in Claim 1, wherein said composition can doped with 0.02~0.06 wt.% Fe and 1.5~6.5 mol.% Zn, while the congruent composition is [Li]/[Nb]=0.87~0.95.

5. A process for growing doubly doped lithium niobate crystal as claimed in anyone of Claim 1 -4, wherein said process includes the following steps:

(1) Weigh up high purity Li_2CO_3, Nb_2O_5, Fe_2O_3, and MgO, In_2O_3 or ZnO powders according to the crystal composition, and dry them at 120~150°C, then thoroughly mix them lasting for 24 hours, and keep them at 800~850°C for 2~5 hours to make Li_2CO_3 decompose sufficiently, and then sinter at 1050~1150°C for 2~8 hours to obtain doubly doped lithium niobate powder.

(2) Put the above doped lithium niobate powder into a Pt crucible after impacted, then heat the powder by a middle frequency stove; Grow the doubly doped lithium niobate crystals using the Czochralski pulling method along c or a axis via the procedures of necking, shouldering, uniform-diametering, and tailing,

with the pulling rate being 1~3 mm/h, the rotation rate being 15~30 rpm, the temperature difference of the melt-crystal interface being 20°C, the temperature gradient in the melt volume near the surface being 1.5°C/mm, and the temperature gradient above the melt surface being 1.0°C/mm, respectively.

(3) Pole and anneal the grown doped lithium niobate crystals at 1200°C to obtain single-domained doubly doped lithium niobate crystals

6. A usage of said doubly doped lithium niobate crystals claimed in Claim 1, wherein said doubly doped lithium niobate crystals can be used for a three-dimensional optical storage material.